# Introduction to Psychology
# Experimental Psychophysiology Laboratory

Name: _____ Date: _____

**Lab Exercise EMG-1: Electromyography (EMG)**
In this exercise, we will explore the basis of skeletal muscle cell and nerve function. We will use the muscles in your arm, measuring the tension that develops during clenching your fist. As part of the laboratory, you will propose a hypothesis, and we will collect data, and analyze that data to confirm or disconfirm your hypothesis.

Here's what is known about skeletal muscle tissue function:

- Your central nervous system (CNS) communicates with the somatic nervous system (part of your peripheral nervous system) to control voluntary motor movement.
- When you want to move a muscle, your brain activates nerves along your spinal cord, which then activates your somatic nerves along three nerve fiber bundles (composed of individual nerve axons) which extend from your spine, down your upper arm, to your forearm. These nerve fibers (called the Medial, Radial, and Ulnar nerves) activate ("innervate") individual muscle fibers in your forearm.
- As you need to contract your muscles more to get them to the desired tension, your somatic nerves stimulate more muscle fibers into action (called "recruitment"). Meanwhile, your somatic nervous system is also sending information back to your CNS regarding how much pressure is being exerted, and your CNS makes adjustments to the muscle tension, all without your conscious action.
- This recruitment of multiple muscle groups causes a measurable amount of electrical voltage at the surface of your skin. The Biopac MP-40 instrument can measure and record these voltages.
- Prior research on the effect of hand dominance on grip strength has yielded mixed results. There is a general rule that the grip strength of the dominant hand is about 10% more than the non-dominant hand, which has been supported in several studies. Some studies, though, have found this true only for right-hand-dominant individuals, and others have found it true for only left-hand-dominant individuals (see Ertem, et al., 2005 for a review).

**Steps in scientific exploration:**
1. Propose a hypothesis (a prediction based on prior knowledge)
2. Observe and measure behavior
3. Collect and organize data
4. Analyze data
5. Draw conclusions

**Step 1: Propose a hypothesis**
In this step, you will take the information known about a behavior, and propose a prediction of what the data will show, when you expose your participants to the experimental conditions.

Because we only have one Biopac unit, we will have to use the same participant and experimental manipulation for everyone's experiment. The participant in the experiment will be asked to clench his or her fist, as hard as possible, three times. This procedure will be done for the participant's dominant (right- vs. left-handed) arm, and then for the non-dominant arm.

This experimental procedure will yield averages of muscle tension levels (as indicated by the electrical voltage measured at the skin) for the dominant arm and the non-dominant arm, when making a fist with the hand. These should approximate the amount of grip strength being exerted in the hand.

When you propose a hypothesis, you might think about one (or more) of the following:

- What differences would you expect between the dominant and non-dominant arms?
- What reasons would you propose to account for those differences?
- Do you believe that right- vs. left-handedness will have an effect?

My hypothesis is:

**Step 2: Observe and measure data.**
This step will be done by me, and a participant from the class. The steps I will do are:

1. Explain the procedure to the participant.
2. Obtain verbal informed consent (written informed consent was obtained earlier).
3. Place the electrodes on the arms.
4. Ask the participant, starting with the dominant hand, to clench his or her fist three times, as hard as possible.
5. The electrode wires are switched to the other arm, and the previous step is repeated for that arm.
6. Inform the participant the procedure is over, and answer any questions he or she might have.

7. The data are then reported using the Biopac Science Lab software, obtaining Mean EMG readings for each clench on both arms.

**Step 3: Collect and organize data.**
In order to analyze the data, you need to organize it into an easily readable form. Use this table to record the mean EMG data for each clench strength on each arm:

| Clench Number | Dominant Mean EMG | Non-Dominant Mean EMG | Delta % |
|---|---|---|---|
| **1** | | | |
| **2** | | | |
| **3** | | | |
| **Mean (average)** | | | |

**Step 4: Analyze data.**
You can now see what the differences were between the dominant and non-dominant arms. In order to quantify those differences for better analysis and reporting, lets calculate the percentage EMG strength (tension) of the dominant arm vs. the non-dominant arm. For this step, we will only use the average of the 3 dominant clenches and the average of the 3 non-dominant clenches. Use this formula:

$$\frac{M_d - M_n}{M_n} \times 100$$

where: $M_d$=mean EMG for the dominant hand and $M_n$=mean EMG for the non-dominant hand (those values are in the last row of the table above)

For example, if the dominant hand was 100 and non-dominant hand was 80, then calculate $\frac{(100-80)}{80} \times 100$ = 25, meaning the dominant arm had 25% **greater** tension than the non-dominant arm. If the dominant was 80, and the non-dominant was 100, calculate $\frac{(80-100)}{100} \times 100$ = –20, meaning the dominant arm had 20% **less** tension than the dominant hand

Record your calculation and results here:

The _____ (dominant/non-dominant) arm showed _____%

_____ (more/less) tension than the _____ (dominant/non-dominant) arm.

**5. Draw Conclusions.**

Now that you have your data, and you have analyzed them, you can now state whether or not your hypothesis is supported by the data. You can write this in any way you want, but please be specific. Don't just write "the dominant hand was stronger than the non-dominant hand." Tell me how much stronger. Did the results agree with the previous research? What other interesting findings did you find, regardless of the hypothesis? Were there factors not measured which you believe would affect the results? What are those factors, and how do you think they might affect the results?

Use the space below to write your conclusions.

Reference:
Ertem, K., Harma, A., Cetin, A., Elmali, N., Yologlu, S., Bostan, H., & Sakarya, B. (2005). An investigation of hand dominance, average versus maximum grip strength, body mass index, and ages as determinants for hand evaluation. *Isokinetics and Exercise Science, 13*, 223–227.

# PSY 201A Introduction to Psychology, Part 1
# Experimental Psychophysiology Laboratory

Student Name: _____ Date: _____

**Lab Exercise 2: Electrooculography (EOG)**
Electrooculography is the measurement of eye movement and position. In this exercise, we will examine the relationships between eye movement and brain processes related to reading. As with the previous lab exercise, you will propose a hypothesis, and we will collect data, and analyze that data to confirm or disconfirm your hypothesis.

**Background**:

- Your eyes form an electrical "dipole," which is like a battery: one side is positively charged relative to the other, more negatively charged, side. In the case of your eyes, the front of your eye (at the cornea) has more of a positive charge than the rear (at the retina).
- If we measure the voltage at the outer sides of your eye, looking left or right will cause a rise in voltage at the edges, which can be measured by the Biopac MP40. Therefore, we'll put our electrodes on the outer sides of your eyes to measure your horizontal (left-right) eye movement. We could, if we wanted, place them above and below your eyes to measure vertical (up-down) eye movement.
- When you read, your eyes and your brain have to work in synchrony. Your brain initiates and stops eye movement, and your eyes are sending information to your brain about what is in your visual field. If you need to see something different in your visual field, your brain has to signal your eye muscles to move them appropriately.
- For example, if you read a word you do not understand, or are having trouble comprehending the material, your brain will need to tell your eyes to reread that material so it can make sense of it. On the other hand, if a passage is easy to read and comprehend, your eyes will sail over the words comparatively easily. This will affect the speed of reading, such that reading for simpler material is typically faster.
- These motions to reread and recomprehend are called "***saccades***," and will typically occur at a higher rate in more difficult reading materials.

**Steps in scientific exploration:**
1. Propose a hypothesis (a prediction based on prior knowledge)
2. Observe and measure behavior
3. Collect and organize data
4. Analyze data
5. Draw conclusions

**Step 1: Design the experiment and propose a hypothesis**
In this step, you will take the information known about a behavior, and propose a prediction of what the data will show, when you expose your participants to the experimental conditions.

Because we only have one Biopac unit, we will have to use the same participant(s) and experimental manipulation(s) for everyone's experiment.

But—as some of you noted in the first lab exercise, there were **methodological problems** and **factors not measured** in the first lab might have influenced the results (e.g. sex, participants' knowledge of the hypothesis, experience prior to the experiment, sleep levels, small sample size, nonrandom sampling).

This exercise will allow you to correct some of those errors, by suggesting changes the methods as well as the hypothesis. I am correcting a couple: using both sexes, using random selection, and keeping the participants blind to the hypothesis.

I will impose a couple of things on your methods. One is that I will select 2 participants at random: one male, and one female. The other is that the participants will be required to read two short passages of text. One will be relatively easy to read, and the other will be relatively hard to read. Other than that, you are free to propose any other methods for your experiment. BUT—you need to agree as a class what to do, so we only need to run the participants through the procedure once.

**Methods:**
Two participants will be chosen randomly from the classroom. They will be taken to another location, where two electrodes will be placed 5 mm from the outer edge of each eye. After their classmates have proposed a hypothesis, the participants will be brought back into the classroom, and in turn, will be asked to read two passages of text. One passage will be a relatively easy passage, and one will be a relatively difficult passage. While reading, electrooculography measurements will be taken. The time to read each line of text will be measured, as well as the number of saccades for each line.

Here are the two passages, as given to the participants:

Easier text (appx. 10th grade level):

The dog sat on the grass near the house, his tongue out. There was a red collar around his neck. A long cable wound from his red collar to a hook on the house. It was strong. The boy knew it was strong. Everyone knew it was

More difficult text (chapter from an academic book):

Unlike adherents of some other approaches to cognitive styles, conceptual complexity theorists argued that highly complex cognition involves not only the recognition of alternatives, nuances, and new information; it also

What other method changes would you like to propose? Think of other variables you'd like to measure which might affect the results. Write them below:

**Hypothesis:**
When you propose a hypothesis, you might think about one (or more) of the following:

- How would you expect the difficulty of the material to affect reading speed?
- Do you think there will be differences in the number of saccades per line between harder and easier material?
- What other factors that we're measuring do you think will affect the dependent variables?

My hypothesis is:

**Step 2: Observe and measure data.**
This step will be done by me, and a participant from the class. The steps I will do are:

1. Explain the procedure to the participant.
2. Obtain verbal informed consent (written informed consent was obtained earlier).
3. Place the electrodes on the face.
4. Ask the participant to read the easier text material while I record the eye movement data.
5. Do the same for the more difficult reading material.
6. Inform the participant the procedure is over, and answer any questions he or she might have.
7. The data are then reported using the Biopac Science Lab software, obtaining time per line and number of saccades per line for each reading difficulty level.

**Step 3: Collect and organize data.**
In order to analyze the data, you need to organize it into an easily readable form. Use these tables to record the dependent variables for each participant and each condition:

**Record some information about each participant here:**

| Participant | Sex (circle) | Other characteristics |
|---|---|---|
| 1 | Male / Female | |
| 2 | Male / Female | |

**Easier reading material (sample 1):** **Harder reading material (sample 2):**

| Participant 1 | Time to read | Number of saccades | | Participant 1 | Time to read | Number of saccades |
|---|---|---|---|---|---|---|
| Line 1 | | | | Line 1 | | |
| Line 2 | | | | Line 2 | | |
| Line 3 | | | | Line 3 | | |
| Mean (average) values | | | | Mean (average) values | | |
| **Participant 2** | | | | **Participant 2** | | |
| Line 1 | | | | Line 1 | | |
| Line 2 | | | | Line 2 | | |
| Line 3 | | | | Line 3 | | |
| Mean (average) values | | | | Mean (average) values | | |
| Mean for both participants | | | | Mean for both participants | | |

**Step 4: Analyze data.**
Now we have the mean time to read each line of text and number of saccades per line for both the easier material condition and harder material condition. Let's summarize this information:

**Participant 1** showed a mean time per line of _____ seconds, and mean saccades of _____ per line, when reading the easier text material. When reading harder text material, the participant showed a mean time per line of _____ seconds, and mean saccades of _____ per line.

**Participant 2** showed a mean time per line of _____ seconds, and mean saccades of _____ per line, when reading the easier text material. When reading harder text material, the participant showed a mean time per line of _____ seconds, and mean saccades of _____ per line.

When looking at the **average of both participants**, there was a mean time per line of _____ seconds, and mean saccades of _____ per line, when reading the easier text material. When reading harder text material, the participant showed a mean time per line of _____ seconds, and mean saccades of _____ per line.

Do you see any patterns or trends in the above data?

**5. Draw Conclusions.**

Now that you have your data, and you have analyzed them, you can now state whether or not your hypothesis is supported by the data. You can write this in any way you want, but please be specific. Also consider what other interesting findings were in the data, regardless of the hypothesis? Were there factors not measured which you believe would affect the results? What are those factors, and why do you think they might be a factor?

Use the space below to write your conclusions.

# Introduction to Psychology
# Experimental Psychophysiology Laboratory #2

Student Name: _____ Date: _____

**Lab Exercise 2: Electroencephalography (EEG-1)**
Electroencephalography is the measurement of brain waves - electrical activity arising in the cerebral cortex. In this exercise, we will examine the measurement of brain processes related to problem solving. As with the previous lab exercises, you will propose a hypothesis, and we will collect data, and analyze that data to confirm or disconfirm your hypothesis.

**Background**:

- What we commonly refer to "brain waves" are the patterns of electrical activity that are associated with various activities in your brain. This activity is central to our idea of life—24 hours of no brain wave activity is referred to as "*brain dead*."
- Brain waves in specific *frequency* ranges are referred to as "alpha" (8–12 Hz), "beta" (13–30 Hz), "theta" (5–7 Hz), "delta" (.5–4 Hz) and "gamma" (30–90 Hz).
- The *amplitude* of brain waves refers to the electrical strength (measured in millivolts, $\mu$V): alpha & delta: 20–200 $\mu$V; beta & gamma: 5–10 $\mu$V; theta: 10 $\mu$V.
- Remember from your study of sleep that your brain waves pass through predictable stages from alpha (stage 1) to theta (stage 2 & 3) to delta (stage 4).
- Alpha waves are associated with relaxed states we enter through relaxation and when we are falling asleep.
- Beta waves are associated with alertness and attention to external stimuli, and when we are engaged in mental activity. These waves are also present during REM sleep.
- Delta and theta waves are associated with deeper stages of sleep.
- Gamma waves are likely related to integrating complex stimuli into a coherent whole (remember the "gestalt"?)
- Females tend to have higher mean <u>frequencies</u> of alpha waves than males, although the differences are quite small.
- Alpha wave <u>amplitudes</u> tend to be higher in extraverted (outgoing) individuals.
- Greater <u>amplitudes</u> of alpha waves are associated with greater levels of relaxation.
- Greater <u>amplitudes</u> of beta waves are associated with more difficult mental processing tasks (when performed with the eyes closed).
- The software we have will separate your brain waves into the alpha, beta, theta, and delta waves, and allow us to measure frequency and amplitude.

**Steps in scientific exploration:**
1. Design the experiment and propose a hypothesis (a prediction based on prior knowledge)

2. Observe and measure behavior
3. Collect and organize data
4. Analyze data
5. Draw conclusions

**Step 1: Design the experiment and propose a hypothesis**
In this step, you will take the information known about a behavior, and propose a prediction of what the data will show, when you expose your participants to the experimental conditions.

Because we only have one Biopac unit, we will have to use the same participant(s) and experimental manipulation(s) for everyone's experiment.

**Methods:**
As some of you noted in the first lab exercise, there were **methodological problems** and **factors not measured** in the first lab which might have influenced the results (e.g. participant sex, participant knowledge of the hypothesis, experience prior to the experiment, sleep levels, small sample size, etc.).

This exercise will allow you to correct some of those errors, by suggesting changes the methods as well as the hypothesis. I am correcting a couple: using both sexes, using random selection, and keeping the participants blind to the hypothesis.

I will impose a couple of things on your methods:

Two participants (one male, one female) will be chosen randomly from the classroom. They will be taken to another location, where two electrodes will be placed on the back of the scalp, in what are known as the $O_1$ and $O_2$ positions of the international 10–20 electrode system. After their classmates have proposed their hypotheses, the participants will be brought back into the classroom, and in turn, each will be asked to do the following in this order, while EEG measurements are taken:

1. Relax with eyes closed (this is the control condition)
2. Perform mental math with eyes closed (this is the experimental condition)

We will measure these **3 dependent variables**:

1. Frequency of alpha waves
2. Amplitude of alpha waves
3. Amplitude of beta waves

Would you like to propose any changes to the methods? Other independent variables you'd like to manipulate? What other dependent variables might you like to measure which you think might affect the results? Write these proposed changes below:

**Hypothesis:**
When you propose a hypothesis, you might think about one (or more) of the following:

- What differences do you think there will be between the male and female participants?
- How might you expect the frequency and/or amplitude of the EEG to differ between the control and experimental conditions?
- What other factors that we're measuring do you think will affect the amplitude of the EEG waves, and what would your prediction of these effects be?

My hypothesis is:

**Step 2: Observe and measure data.**
This step will be done by me, and each participant from the class. The steps I will do are:

1. Explain the procedure to the participant.
2. Obtain verbal informed consent (written informed consent was obtained earlier).
3. Place the electrodes on the scalp.
4. Ask the participant to relax with eyes closed.
5. Give the participant a verbal math problem to solve with eyes closed.
6. Inform the participant the procedure is over, and answer any questions he or she might have.
7. The data are then reported using the Biopac Science Lab software, obtaining alpha and beta wave amplitude and frequencies.

**Step 3: Collect and organize data.**
In order to analyze the data, you need to organize it into an easily readable form. Use these tables to record the dependent variables for each participant and each condition:

**Record some information about each participant here:**

| Participant | Sex (circle) | Other characteristics |
|---|---|---|
| **1** | Male / Female | |
| **2** | Male / Female | |

| Participant 1 | Alpha Amplitude (mean $\mu$V) | % difference from control | Beta Amplitude (mean $\mu$V) | % difference from control | Alpha Frequency (Hz) |
|---|---|---|---|---|---|
| Eyes closed, relaxed | | | | | |
| Eyes closed, Math | | | | | |
| **Participant 2** | | | | | |
| Eyes closed, relaxed | | | | | |
| Eyes closed, Math | | | | | |

**Step 4: Analyze data.**
Now we have the amplitude and frequency information for each participant. Let's see how the experimental conditions differ from the control condition (eyes closed, relaxed):

**Participant 1:**

The **alpha frequency** was _____ Hz.

The **alpha amplitude** for the Eyes closed, Math condition was _____ % _____ (more or less) than the control condition.

The **beta amplitude** for the Eyes closed, Math condition was _____ % _____ (more or less) than the control condition.

**Participant 2:**

The **alpha frequency** was _____ Hz.

The **alpha amplitude** for the Eyes closed, Math condition was _____ % _____ (more or less) than the control condition.

The **beta amplitude** for the Eyes closed, Math condition was _____ % _____ (more or less) than the control condition.

**Do you see any patterns or trends in the above data? Write them below:**

**5. Draw Conclusions.**

Now that you have your data, and you have analyzed them, you can now state whether or not your hypothesis is supported by the data. You can write this in any way you want, but please **be specific**. Aside from your hypothesis, also consider what **other interesting findings** were in the data, regardless of the hypothesis! What might explain these unexpected findings? Were there factors not measured which you believe would affect the results? What are those factors, and why do you think they might be a factor? How might you design the experiment differently to address these problems?

**Use the space below to write your conclusions (feel free to use the back of this page also, or even to attach a separate page).**

# Social Psychology
# Experimental Psychophysiology Laboratory

Name: _____ Date: _____

**Lab Exercise 1: Emotion, Attitudes and Facial Electromyography**
In this laboratory exercise, you will get a chance to examine how we can measure something that is normally an internal, private state: emotion and attitudes. To do this, we will perform an experiment to measure the relationship between subjective emotional experience and facial muscle movement. As part of the laboratory, you will *propose a hypothesis*, and we will *collect data*, and *analyze that data* to *support or refute your hypothesis*.

Here's what is known about emotion and facial muscle movements:

- An attitude is a broadly positive or negative affective (emotional) response to some stimulus.
- Emotional states are indicated to others by non-verbal, facial displays. However, even in the absence of facial displays detectable by others, your face has small, undetectable facial muscle movements in response to emotional states (see Cacioppo, Petty, Losch, & Kim, 1986; Santerre & Allen, 2007).
- These facial muscle movements occur reliably in the presence of emotional states in at least two muscle groups: the *corrugator supercilia*, and the *zygomatic major* muscles.
- The *corrugator* muscles run along your eyebrows, pulling your brow inward, and experience activation when you feel sad and angry. The *zygomatic* muscles run from the corner of your mouth along your cheekbones, pulling your face into a smile, and these muscles are activated when you feel happy (Schwartz, Fair, Salt, Mandel, & Klerman, 1976).
- Various stimuli are used to induce a mood state in a person. These stimuli include exposing a participant to sounds, movies, or photographs (Bradley & Lang, 2007), and also by having participants imagine and visualize a scene from a happy or sad moment in their lives (Cacioppo, Petty, Losch, & Kim, 1986; Sirota & Schwartz, 1982)
- Using electromyography (EMG), we can measure the activation of the corrugator and zygomatic muscle groups in response to a stimulus such as pleasant or unpleasant images. If we compare between each type of image, we should be able to see some differences in the activation levels in both of these muscle groups.

**Steps in scientific exploration:**
1. Propose a hypothesis (a prediction based on prior knowledge)
2. Observe and measure behavior
3. Collect and organize data

4. Analyze data
5. Draw conclusions

**Step 1: Propose a hypothesis**
In this step, you will use your observations and prior research to propose a prediction of what the data will show when you expose your participants to the experimental conditions.

Because we only have one Biopac unit, we will have to use the same participant and experimental manipulation for everyone's experiment. The participant in the experiment will be asked to observe a slide show of pleasant (babies, families, and small animals) and unpleasant (pollution and human assault) images.

While the participant watches the slide show, we will measure muscle activity in the corrugator and zygomatic muscles. We can then compare the activity between the two conditions.

When you propose a hypothesis, you might think about one (or more) of the following:

- What differences would you expect in corrugator muscle activity between the pleasant and unpleasant image conditions? What about activity in the zygomatic muscles?
- What reasons would you propose to account for those differences?

My hypothesis is:

**Step 2: Observe and measure data.**
This step will be done by me, and a participant from the class. The steps I will do are:

1. Explain the procedure to the participant.
2. Obtain verbal informed consent (written informed consent was obtained earlier).
3. Place two pairs of electrodes on the participant's face. One pair will be above the brow, and the other pair on the cheek. One electrode will be placed in the center of the forehead as a reference, or ground, lead.

4. Connect the electrodes to the wires from the BioPac MP-40 to measure corrugator activity (above the brow).
5. Ask the participant to watch the slide show of pleasant and unpleasant images.
6. EMG data will be collected from the corrugator muscles while the participant watches the first set of images.
7. Steps 5 and 6 will be repeated for the zygomaticus muscles.
8. Inform the participant the procedure is over, and debrief the participant, explaining the hypothesis and procedures, and answering any questions he or she might have.
9. The data are then reported using the Biopac Science Lab software, obtaining mean (average) integrated EMG readings for each of the conditions, and for both muscle groups.

**Step 3: Collect and organize data.**
In order to analyze the data, you need to organize it into an easily readable form. Use this table to record the mean EMG strength data for each condition in each muscle:

| **Raw Data** | | | | | |
|---|---|---|---|---|---|
| **Corrugator Mean EMG (mV)** | | | **Zygomaticus Mean EMG (mV)** | | |
| **Image** | **Pleasant** | **Unpleasant** | **Image** | **Pleasant** | **Unpleasant** |
| 1 puppies | | | | | |
| 2 pollution | | | 2 baby | | |
| 3 kitten | | | 3 family | | |
| 4 baby | | | 4 assault | | |
| 5 pollution | | | 5 rabbits | | |
| 6 duck in oil | | | 6 pollution | | |

| **Summary Data** | | | | |
|---|---|---|---|---|
| | **Corrugator (brow) Muscles** | | **Zygomatic (cheek) Muscles** | |
| **Condition** | **Mean EMG (mV)** | **% difference from mean** | **Mean EMG (mV)** | **% difference from mean** |
| **Pleasant** | | | | |
| **Unpleasant** | | | | |
| **% difference from mean** | | | | |

**Step 4: Analyze data.**
Now that you have the data collected and organized into a table, it might be helpful to record your results here:

The corrugator muscles showed (more / less) EMG activation than zygomaticus in the **pleasant** condition, and (more / less) EMG activation than zygomaticus in the **unpleasant** condition.

The zygomaticus muscles showed (more / less) EMG activation than corrugator in the **pleasant** condition, and (more / less) EMG activation than corrugator in the **unpleasant** condition.

**5. Draw Conclusions.**
Now that you have your data, and you have analyzed them, you can now state whether or not your hypothesis is supported by the data. You can write this in any way you want, but please be specific. Don't just write "there was more zygomatic EMG activation in the pleasant condition." Tell me how much more, in relationship to the unpleasant condition. Was the hypothesis supported or refuted by the data? Did your results agree or disagree with the previous research? What other interesting findings did you observe, regardless of the hypothesis? Were there factors **not** measured which you believe would affect the results? What are those factors, and how do you think they might affect the results?

Use the space below to write your conclusions.

References:

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# Experimental Psychophysiology Laboratory

**PSY 202A Introduction to Psychology, Part 2 — Dana C. Leighton**
**Portland Community College**

Name: _____ Date: _____

**Lab Exercise 2: Stress, Pain, and Biofeedback**

*Stress* is your body's response to a perceived threat. When you experience stress, your body responds involuntarily by activating the *sympathetic branch* of the *autonomic nervous system* (sympathetic nervous system, SNS), which increases our readiness to run away or confront the threat ("fight or flight" response). The autonomic nervous system is generally thought of as being outside our voluntary control.

In this lab, we will see the natural stress response in action, when we expose a participant to a stressful (and moderately painful) stimulus. We'll also attempt to teach the subject *biofeedback*, to voluntarily increase the activity of the *parasympathetic branch* of his or her autonomic nervous system, reducing arousal, and perhaps reducing his or her subjective experience of pain. As part of the laboratory, you will *propose a hypothesis*, and we will *collect data*, and *analyze that data* to *confirm or disconfirm your hypothesis*.

Here's what is known about stress, pain, and biofeedback:

- When you experience stress, your body's SNS is activated, resulting in increased blood pressure, heart rate, and blood sugar changes. These bodily changes allow you to respond to the stressor as appropriate, by running away from or confronting it.
- Laboratory studies sometimes use the cold pressor test (CPT) to cause a generalized activation of the sympathetic nervous system. The cold pressor test typically has a participant put his or her hand in a container of ice cold (1–5° C) water, up to the wrist. The initial response to the CPT is a feeling of cold and wetness, which is gradually replaced by a feeling of deep, aching pain (Zvan, Zaletel, Pretnar, Pogacnik, & Kiauta, 1998).
- Studies have reported consistent heart rate (beats per minute, BPM) changes in response to the CPT. Generally, BPM increases during the administration of the CPT. More specifically, it rises rapidly, reaching a peak at about 1 minute, and then gradually declines (Alden, Dale, & DeGood, 2001; James & Hardardottir, 2002; Sharpley & Gordon, 1998; Victor, Mainardi, & Shapiro, 1978).
- Biofeedback (BFB) is an easily learned way to control heart rate, and using BFB during the CPT was shown to reduce the reported severity of pain (Victor, Mainardi, & Shapiro, 1978). BFB is often taught by allowing the participant to control his or her heart rate while monitoring a visual indicator (a rising and falling bar chart), or auditory signal (rising and falling pitch) representing changes in heart rate. The usual procedure is to have the participant do 25 trials, 30–45 seconds each, of heart rate control with feedback. When the participant succeeds in reducing heart rate, rewards

are given to operantly condition the behavior (cf. Reeves & Shapiro, 1982, 1983; Victor, Mainardi, & Shapiro, 1978).

- Pain caused by the CPT has generally been shown to parallel biofeedback-induced heart rate changes. That is, when participants are instructed to use biofeedback to increase heart rate during the CPT, they report higher pain levels than those instructed to use biofeedback to decrease heart rate (Reeves & Shapiro, 1982). However, these studies have usually ended the CPT prior to the decline in heart rate which occurs after about 1 minute.
- The pain associated with the CPT has been measured in a variety of ways: having participants circle pain-related adjectives describing the pain intensity, placing a mark along a 10 cm line from no pain to intense pain, and using numeric scales (cf. Alden, Dale, & DeGood, 2001; James & Hardardottir, 2002; van den Hout, Vlaeyen, Peters, Engelhard, & van den Hout, 2000; Reeves & Shapiro, 1982; Victor, Mainardi, & Shapiro, 1978)
- Using electrocardiography (ECG), we can measure heart rate, and also give the participant a visual indication of heart rate that will be used to train him or her in the biofeedback procedure.

**Steps in scientific exploration:**

1. Propose a hypothesis (a prediction based on prior knowledge) & design the study
2. Observe and measure behavior
3. Collect and organize data
4. Analyze data
5. Draw conclusions

**Step 1: Propose a hypothesis & design the study**

In this step, you will use your observations and prior research to propose a prediction of what the data will show when you expose your participants to the experimental conditions.

Because we only have one Biopac unit, we will have to use the same participant and experimental manipulation for everyone's experiment. Here is the procedure that will be followed:

1. I will explain the experimental procedure to the participant, omitting the effect biofeedback has on pain perception and tolerance. The participant will be told that the procedure will be cold and painful, but not dangerous.
2. After I connect to the BioPac lead wires, and run the BioPac diagnostic tests, the participant will be instructed to sit quietly for 1 minute to let his or her body adjust to the experimental condition.
3. A baseline heart rate will be collected for a 1 minute period prior to the CPT. Every 15 seconds during the baseline, the participant will be asked for a rating of pain

severity, on a numeric scale of 1 (no pain) to 10 (extremely painful. This will familiarize the participant with the pain reporting procedure.

4. The participant will then be instructed to place his or her non-dominant hand into the cold water up to the wrist, and to leave it there until the pain becomes too great to tolerate. Heart rate data will be collected, and every 15 seconds a pain severity rating will be collected. The trial will be stopped at 4 minutes if the participant does not stop it earlier.
5. Then the participant will be trained to use biofeedback for reduction of heart rate using operant conditioning. Because of limited time, we will use 15 trials of 30 seconds followed by 10 seconds rest (10 minutes total). Each trial where the participant succeeds in reducing heart rate by 2 BPM below the previous trial's minimum BPM will result in a $.10 reward, and a reduction of 4 BPM will result in a $.25 reward.
6. Steps 3 & 4 will be repeated, except that during the CPT, the participant will be instructed to use the biofeedback monitor to try reducing heart rate using the same methods learned in the training trials.
7. The participant will be told the experiment has concluded, and will be debriefed regarding the purpose and hypothesis of the study.

The dependent (measured) variables are: _____ and

_____ .

The Independent (manipulated) variable is: _____ .

The experimental condition is: _____, and the control

condition is: _____ .

When you propose a hypothesis, you might think about one (or more) of the following:

- What differences would you expect in heart rate activity between the first baseline (BL1), first cold pressor test (CPT1), second baseline (BL2), and second cold pressor test (CPT2)?
- What differences would you expect in pain severity ratings between CPT1 & CPT2?
- What reasons would you propose to account for those differences?
- Are there any other variables you would expect to influence the results? How would you expect those variables to affect the results?

<u>My hypothesis is</u>:

_____

_____

_____

**Step 2: Observe and measure data.**
This step will be done by me, and a participant from the class. The steps I will do are:

1. Explain the procedure to the participant.
2. Obtain verbal informed consent (written informed consent was obtained earlier).
3. Follow the procedure outlined previously in the hypothesis and design section.
4. The data are then reported using the Biopac Science Lab software, obtaining mean (average) heart rate readings for BL1, CPT1, BL2, and CPT2. The pain severity reports will also be reported.

**Step 3: Collect and organize data.**
In order to analyze the data, you need to organize it into an easily readable form.

First, record some information about the participant and conditions:

Sex (circle): male / female Water temperature: _____° Celcius

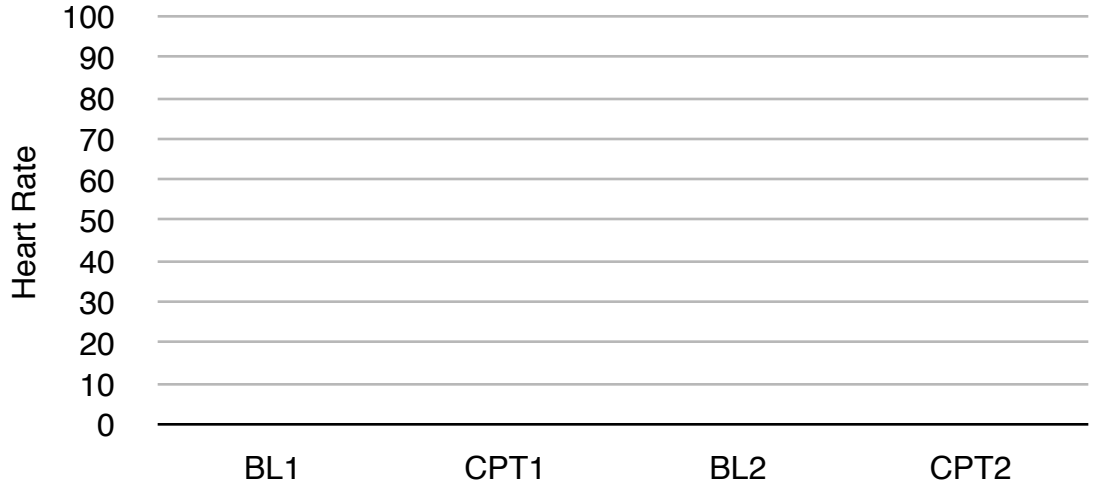
Use this table to record the mean heart rate data for each condition:

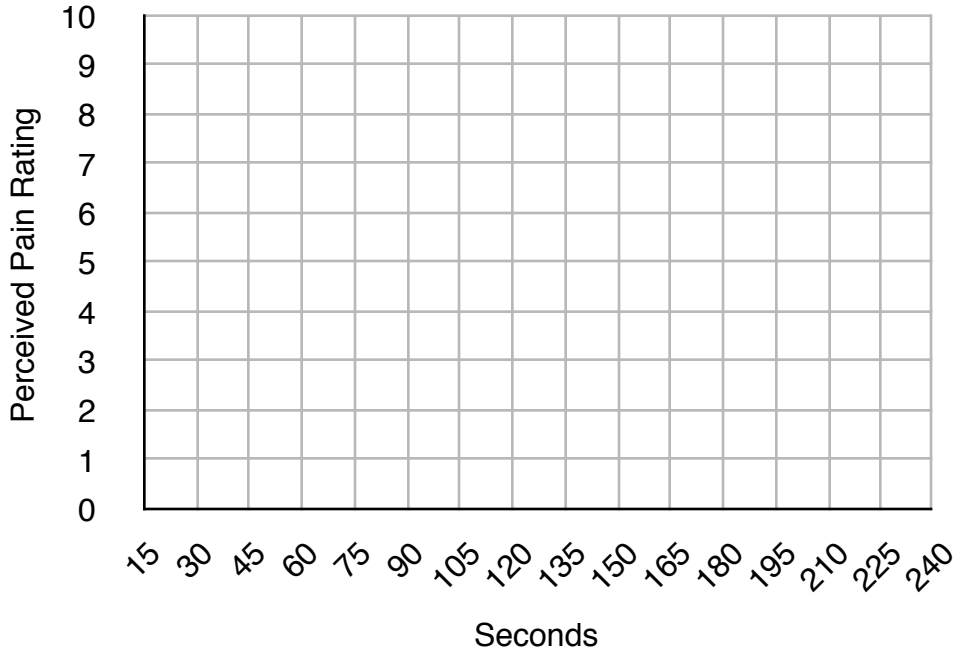
| Condition | Mean Heart Rate (BPM) | Change from Baseline (BPM) | Change from Baseline (%) | Change from CPT1 (BPM) | Change from CPT1 (%) |
|---|---|---|---|---|---|
| **Baseline 1** | | | | | |
| **CPT1** | | 0.0 | | | |
| **Baseline 2** | | | | | |
| **CPT2** | | 0.0 | | 0.0 | |

Use this table to record the **pain perception** data:

| | Seconds | | | | | | | | | | | | | | | | Mean Pain Level |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 15 | 30 | 45 | 60 | 75 | 90 | 105 | 120 | 135 | 150 | 165 | 180 | 195 | 210 | 225 | 240 | |
| CPT1 | | | | | | | | | | | | | | | | | |
| CPT2 | | | | | | | | | | | | | | | | | |

Graph the mean **heart rate data** for each condition:




Now graph the **pain perception data**:

**Step 4: Analyze data.**
Now that you have the data collected and organized into a table, it might be helpful to record your results here:

**Heart rate changes:** The heart rate showed _____ BPM and _____% (higher / lower) from baseline 1 to the the **CPT1** (no biofeedback) condition, and _____ BPM and _____% (higher / lower) from baseline 2 to the **CPT2** (biofeedback) condition.

While using biofeedback in the CPT2 condition, the mean heart rate was _____ BPM and _____% (higher / lower) than when not using biofeedback in the CPT1 condition.

**Pain:** What patterns did you see in the pain perception data?

**Step 5: Draw Conclusions.**
Now that you have your data, and you have analyzed them, you can now state whether or not your hypothesis is supported by the data. This is also your opportunity to state your opinion about the research. You can write this in any way you want, but please be specific. For example, don't just write "the heart rate was lower in the CPT2 condition." Tell me how much lower, in relationship to the CPT2 baseline, and in relationship to the CPT1 condition.

In your conclusion, you might consider the following: Did you see any patterns or trends in the data? Was the hypothesis confirmed or disconfirmed by the data? How do the data confirm or disconfirm the hypothesis? Did the perceived pain ratings match your expectations? Did your results agree or disagree with the previous research? What do the data *mean* in light of previous research, and your hypothesis? What other interesting findings did you observe, regardless of the hypothesis? Were there factors not measured which you believe would affect the results? What are those factors, and how do you think they might affect the results?

Use the following space to write your conclusions.

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